J. DVOŘÁČEK, R. SOUSEDÍKOVÁ, L. DOMARACKÁ

ISSN 0543-5846
METABK 50(1) 53-56 (2011)
UDC – UDK 658.1:338.27:519.23=111

SELECTING INDICATORS OF FUTURE CORPORATE BUSINESS DEVELOPMENT

Received – Prispjelo: 2009-07-20
Accepted – Prihvaćeno: 2010-07-10
Review Paper – Pregledni rad

The paper presents applications of discriminate analysis to predicting corporate economy future developments. The discriminate analysis was applied employing 5 to 8 input indicators (discriminators). Attaining maximum accuracy, 7 discriminators suffice. A final choice of discriminators was made by further discriminate analysis applications, and by searching causes of erroneous classification, which concerned a closer examination of input data files.

Key words: Economic development, Bankruptcy, Discriminate analysis

Odabir pokazatelja budućeg poslovnog razvoja korporacija. U radu se prikazuje aplikacija diskriminirane analize radi predviđanja budućeg razvoja korporacija. Kod diskriminirane analize se primjenjuje 5-8 ulaznih pokazatelja (diskriminatora). Za postizavanje maksimalne točnosti, 7 diskriminatora je dovoljno. Konačni izbor diskriminatora napravljen je prikazanom primjenom diskriminirane analize i pretraživanjem uzroka pogrešnih klasifikacija, koji znače detaljnije ispitivanje ulaznih podataka.

Ključne riječi: gospodarski razvoj, stečaj, diskriminirana analiza

INTRODUCTION

From an economic point of view, business relations between firms are realised by assets and liabilities playing their roles with progressing time. As such it is of major importance whether we are able to predict future economic development of respective business partners. This development may be positive and provide for continued economic partnership or it can lead to default and the breach of standing economic relationship. Originally, financial rations were used for predicting future corporate economy developments. These were used in isolation or their groupings. Later, discriminate analysis methods were widely applied for the purpose. Other non-traditional methods are being researched for applications in the field.

In spite of other methods of applications, discriminate analysis has preserved its special role, being able to categorize clearly, which businesses are operating successfully and for which bankruptcy may be imminent. It is based on successful and bankrupt business data files available. Indicators of business performance are selected concerning both their composition and number. The latter can differ widely. Pindado and Rodrigues [1] employ only 2 financial ratios. Altman [2] originally used 5 ratios, later he used 7 of them [3]. Beaver [4] makes selection out of 30 indexes. Norton and Smith [5] work with 32, primarily ratio indicators. Tam and Kiang [6] used 19 financial ratios, Fitzpatrick [7] employed 13 of these ratio indicators. In spite of extensive research in the field, a definite quantity and quality of indicators could not been commonly acknowledged. The reason is most probably in absence of sufficient theoretical foundations of the empirical studies conducted. A theory for formulation of verifiable hypotheses is needed [8]. We have initially started by investigating disturbances in the circulation of capital as possible causes of default [9]. We are aware of the necessity of the data file expansion and further bussiness investigative effort.

J. Dvořáček, R. Sousedíková, Faculty of Mining and Geology, VSB-Technical University of Ostrava, Czech Republic, L. Domaracká, BERG Faculty, Technical University of Košice, Slovakia

METHOD OF ANALYSIS

The method of discriminate analysis is based on two data files. In our particular case, these files consisted of 85 successfully operating firms, and 85 bankrupt firms. After indicators (discriminators) had been selected, they were used for calculating of linear discriminate function coefficients, and the value of the so called threshold optimum point. Pursuant to linear function coefficients, and values of particular firm discriminators, a linear discriminate function value of a particular firm can be established. If this value exceeds the value of the threshold optimum point, the firm is categorized as a successfully operating business, and vice versa if this not the case, the firm is considered to be in danger of bankruptcy. The same process can be applied for both original files of successful firms and those endangered by default. Comparing correct predictions for each category with number of firms in

each category provides for accuracy percentages within the original files. A more detailed description of the discriminate analysis method was published earlier [9]. Nevertheless, this time we worked with more extensive files, and we applied some discriminators that differed from those used in former studies. These changes concerned: Receivables to Current Assets and Inventories to Current Assets ratios were substituted by Financial Assets to Current Assets ratio, which characterises better a particular firm's liquidity. In the place of Fixed Assets Index, Current Assets Index was employed, as this reacts better to production and selling conditions of a firm, i.e. paying of debts by customers. The Accumulated Earnings Index was abandoned because, for example, increments of profit in two following periods were mathematically interpreted as being identical with increments of losses. For the same reason also the Equity Index was deleted, as many bankrupt firms showed negative equities, i.e. debts exceeded firms' property. The discriminate analysis was conducted with varying numbers of discriminators that were selected out of the following list:

(1) Ratio, $\frac{\text{total laibilities}}{\text{total assets}}$, is a measure of indebtedness. The latter increases if firms have problems with liability increases (firms postpone payments for received goods) or problems with credit increases if a firms receives a credit.

(2) Index, $\frac{\frac{\text{total laibilities, t}-1}{\text{total assets, t}-1}}{\frac{\text{total laibilities, t}-2}{\text{total assets, t}-2}}$, characterises indebtedness development. It normally decreases if a firm operates successfully and increases when a company is in peril of default.

(3) Current Assets Index, $\frac{\text{total laibilities, t}-1}{\text{total assets, t}-2}$, characterises circulation of capital related to production activities (inventories), sale (receivables) and realization of receivables (financial assets).

(4) Production Index, $\frac{\text{total laibilities, t}-1}{\text{total assets, t}-2}$, reflects sales revenues, inventory variations, and own product consumption. As such it characterises a firm's production activities. Exception exists but as a rule, successful businesses increase sale revenues and vice versa.

(5) Ratio, $\frac{\text{financial assets}}{\text{current assets}}$, reflects shares of the most liquid part of property in currents assets. Lack of liquidity leads to payment default and in consequence it is the most frequent cause of bankruptcy declaration.

(6) Ratio, $\frac{\text{current assets}}{\text{total assets}}$, characterises a firm's wealth structure. Successful businesses should have sufficient shares of fixed and current assets that are indispensable if undisturbed circulation of capital is to be sustained.

(7) Ratio, $\frac{\text{sales revenues}}{\text{total assets}}$, which characterises assets productivity. Sales are the most important factors sustaining circulation of capital.

(8) Ratio, $\frac{\text{current liabilities}}{\text{total assets}}$, is measure of a firm's liquidity as current liabilities and their development reflect liquidity.

Concerning successful and bankrupt firms, average values of respective discriminators are given in Table 1.

Initially, discriminators, (1)-(5), were used for applications of discriminate analysis, and then, step by step, discriminators, (6)-(8), were added to further applications. The discriminate analysis results in the form of linear discriminate function and optimum threshold point were employed for feedback assessment of both non-bankrupt and bankrupt firms, which provided for prediction accuracy evaluation. The results are given in Table 2.

RESULTS AND DISCUSSION

Table 1 **Discriminator average values**

	Non-bankrupt	Bankrupt
1. Ratio, Total Liabilities/Total Assets	0,38	2,16
2. Index, Total Liabilities/Total Assets	0,87	1,67
3. Current Assets Index	1,20	0,75
4. Production Index	1,30	0,93
5. Ratio, Financial Assets/Current Assets	0,34	0,07
6. Ratio, Current Assets/Total Assets	0,54	0,59
7. Ratio, Sales Revenues/ Total Assets	1,46	1,67
8. Ratio, Current Liabilities/Total Assets	0,18	1,61

Concerning 5 to 8 discriminators, Table 2 provides for discriminate analysis results by specifying linear discriminate function coefficients, values of optimum threshold point, and results of feedback accuracy assessments for bankrupt and non-bankrupt firms. Taking into account non-bankrupt firms, it is obvious that maximum accuracy has been attained by employing 7 to 8 discriminators. The same accuracy percentage for bankrupt firms has been reached by employing 6, 7, and 8 discriminators. Regarding both bankrupt and non-bankrupt firms, it is possible to maintain that for attaining maximum degrees of prediction accuracy, employing of 7 discriminators is satisfying. Increasing the number of discriminators above this number makes no difference, as far as the feedback prediction accuracy evaluation is concerned.

Concerning 7 variables, specific discriminators given in Table 2 were selected rather on random. For that reason another series of discriminate analysis applications was conducted, where always one discriminator

Table 2 **Discriminate analysis results concerning the number of discriminators, (5) - (8)**

Variable number	Coefficient	Non-bankrupt firms	Bankrupt firms
5 variables, Optimum Threshold Point C=2,13413			
1.	- 0,798	SC: 78,82 %	SC: 90,59 %
2.	0,581	FC: 21,18 %	FC: 9,41 %
3.	1,435		
4.	0,016		
5.	4,809		
6 variables, Optimum Threshold Point C=1,98942			
1.	- 0,264	SC: 81,18 %	SC: 91,76 %
2.	- 0,784	FC: 18,82 %	FC: 8,24 %
3.	0,565		
4.	1,442		
5.	0,016		
6.	4,807		
7 variables, Optimum Threshold Point C=2,03706			
1.	- 0,439	SC: 84,71 %	SC: 91,76 %
2.	- 0,826	FC: 15,29 %	FC: 8,24 %
3.	0,605		
4.	1,456		
5.	0,015		
6.	0,089		
7.	4,795		
8 variables, Optimum Threshold Point C=2,25266			
1.	- 0,341	SC: 84,71 %	SC: 91,76 %
2.	- 0,707	FC: 15,29 %	FC: 8,24 %
3.	0,750		
4.	1,482		
5.	0,014		
6.	0,093		
7.	4,824		
8.	- 0,237		

SC= Successful Classification, FC=Failed Classification

out of the total number of 8 had been deleted. Subsequently feedback prediction accuracy evaluations were performed. The accuracy results for combinations of 7 discriminators are given:

Combination No. 1:
Discriminators: 1, 2, 3, 4, 5, 6, 7
Classification Accuracy: Non-bankrupt 84,71 %, Bankrupt 91,76 %

Combination No. 2:
Discriminators:1, 2, 3, 4, 6, 7, 8
Classification Accuracy: Non-bankrupt 97,65 %, Bankrupt 77,65 %

Combination No. 3:
Discriminators:1, 2, 3, 4, 5, 6, 8
Classification Accuracy: Non-bankrupt 82,35 %, Bankrupt 90,59 %

Combination No. 4:
Discriminators:1, 2, 3, 5, 6, 7, 8
Classification Accuracy: Non-bankrupt 84,71 %, Bankrupt 91,76 %

Combination No. 5:
Discriminators:1, 2, 4, 5, 6, 7, 8
Classification Accuracy: Non-bankrupt 72,94 %, Bankrupt 89,41 %

Combination No. 6:
Discriminators:1, 3, 4, 5, 6, 7, 8
Classification Accuracy: Non-bankrupt 77,65 %, Bankrupt 91,76 %

Combination No. 7:
Discriminators:2,3,4,5,6,7,8
Classification Accuracy: Non-bankrupt 76,47 %, Bankrupt 91,76 %

Combination No. 8:
Discriminators:1, 2, 3, 4, 5, 7, 8
Classification Accuracy: Non-bankrupt 82,35 %, Bankrupt 91,76%.

Further investigations were conducted focusing on default prediction accuracy, as this is of greater importance than it would be the case if successful businesses were taken into account.

Out of the group of bankrupt firms, those were selected by individual combinations that had been assessed successful by the discriminate analysis. Searching of the wrong assessment causes was performed, which was related to particular indicators that implied erroneous values of linear discriminate functions. That provided for highlighting of the ratio indicator, Sales Revenue/Total Assets, as problematic. Many bankrupt firms have had this indicator distorted by extremely low levels of total assets caused primarily by very low levels of fixed assets. Low levels of fixed assets was mainly caused by zero investment, complete depreciation and clearance sale of fixed assets or by intrinsically low level of fixed assets concerning for example service provision companies. These discriminator final values could even be four times greater than it would be the case if the relative ratio indicators concerned non-bankrupt businesses. Concerning linear discriminate function positive coefficients, this indicator increased discriminate function values implying erroneous classification of the given firm.

Consequently, if this error implying discriminator is deleted, the set of discriminators is characterized by combination, No. 3. Here, the assessment accuracy of bankrupt firms differs insignificantly from the highest classification values.

CONCLUSION

The literature on results of discriminate analysis applications, as regards prediction of future economic development of corporate businesses, demonstrates that different authors differ considerably using different number of input indicators (discriminators) of different

construction. In general, it is possible to assume that criterion for selecting a particular discriminator should be in its prediction accuracy potential to classify businesses correctly as successfully operating or in peril of default. In the particular case of our investigations, we came to the conclusion that 7 discriminators suffice for attaining of the highest degrees of prediction accuracy for both groups of firms and that increasing the number of discriminators cannot increase accuracy of prediction.

In the published results of discriminate analysis applications, we could not identify causes of wrong classification concerning original input data files. It is possible to assume that looking for these causes is very important, as it can eliminate discriminators implying erroneous predictions. In our particular case, the difficult indicator has been the ratio, Sales Revenue/Total Assets.

We can assume that selection of discriminators should be based on a theory but that it should be also accompanied by experience of practical application providing for corrective action. This concerns both the discriminate analysis applications themselves and the search for causes of erroneous predictions. The selection of appropriate discriminators can provide for higher prediction accuracies, as regards future economic development of corporate businesses. Periods of general uncertainty and economic turmoil imply special need for predicting accurately future economic development.

REFERENCES

[1] J. Pindado, L. Rodriques, Parsimonious Models of Financial Insolvency in Small Companies, 2001 [online]. [cit. 2009-06-14]. (available at SSRN: http://ssrn.com/abstract=283782).
[2] E. I. Altman, Journal of Finance, 23 (1968) 4, 589-609.
[3] E. I. Altman, Predicting financial distress of companies: Revisiting the Z-score and ZETA models, 2000 [online]. [cit. 2009-05-20]. (available at http: //pages.stern.nyu.edu/∼@ altman/Z scores.pdf).
[4] W. BEAVER, Journal of Accounting Research, 4 (1966) Empirical Research in Accounting: Selected Studies, 71-111.
[5] C. L. Norton, R. E. Smith, Accounting Review, 54 (1979)1, 72-87.
[6] K. Y. Tam, M. Y. Kiang, Management Science 38 (1992)7, 926-947.
[7] P. J. Fitzpatrick, Certified Public Accountant (1932) (October, November and December): 598-605, 656-662, 727-731.
[8] S. Hol, S. Westgaard, N. van der Wijst, Capital structure and the prediction of bankruptcy, 2002 [online]. [cit. 2009-05-20]. (available at http: www.cs.sunysb.edu/∼mverma/capitalstructureandbankruptcy.pdf)
[9] J. Dvořáček, R. Sousedíková, L. Domaracká, Metalurgija, 47 (2008) 1, 33-36.

Note: The responsible translator for English language is Borek Sousedík, Ostrava, Czech Republic